CHAPTER - I

INTRODUCTION

SCOPE AND OBJECTIVE

The district of Banaskantha in North Gujarat is unique from the point of view of geoenvironmental diversity and water resources complexities. It comprises that part of the western India, where the margin of the Thar desert meets the alluvial plains of Mainland Gujarat and is characterised by a transitional zone from the climate point of view showing increasing aridity northward. Apart from the factor of climate, the landscape of Banaskantha is marked by striking terrain diversity. Within the limits of this district lie three very distinct units viz., Eastern Rocky Highland (ERH), Central Alluvial Plain (CAP) and Western Saline Wasteland (WSW).

Its eastern part is rocky terrain and is made up of folded and faulted Precambrian, while the western extremity forms a wasteland merging into the Rann of Kachchh. The median portion is made up of fluvial and fluvio-aeolian pedogenised Quaternary sediments supporting a reasonably rich agriculture. In fact, this fertile alluvial plains is the northern extension of the plain of Mehsana district. Each of these geoenvironmental units, not only show its own distinctive landscape characteristics and geological features, but is found to differ in respect of surface and groundwater regimes.

This study aims at a thorough appraisal of the various geoenvironmental factors responsible for the production of terrain features and water regimes in the three units of Banasknatha. Perhaps, this district is the only one in western India where a marked variation in the terrain attributes and water regime is seen to prevail over the geoenvironmental conditions.

As it is always the usual practice for the funding agencies, governmental or non-governmental, to identify district as a unit for providing developmental support, this study has therefore followed the limits of the administrative boundary to conform to the prevalent

strategy commonly followed. The area falling within the district provides an ample scope for appropriate developmental strategy, and the study highlights the need for proper geoenvironmental understanding and formulating integrated action plan.

The Investigations carried out by the present author have for the first time provided a reasonably clear picture of the diverse combinations of the factors of physiography, climate and geology . Broadly speaking, the geology of Banaskantha is mainly represented by the Precambrian Crystallines (Metasediments of Delhi Supergroup with associated intrusives) and the late Quaternary unconsolidated sediments. Geomorphologically, the district shows interesting assemblages of landforms, topographic variations and drainage characteristics. Obviously, these landscape characteristics are the reflections of the rock types, tectonic framework and depositional environments of fluvial, aeolian and marine processes. The factors responsible for the geoenvironmental diversity, namely geology (lithology and tectonics), climate (rainfall, temperature and wind), terrain attributes (landforms, ground slope, drainage and soils) and water regimes (surface water reservoirs, lakes and ponds and groundwater aquifer systems), have been systematically analyzed; the main objective being that of arriving at an integrated picture of the geoenvironment of Banaskantha and its water resource potential.

METHODOLOGY

Keeping in mind the scope of the study and the objectives, an appropriate strategy for carrying out the investigations was worked out. Main purpose was to obtain optimum information in respect of the controls exercised by various geoenvironmental factors, and the actual methodology was so chalked out as to fulfill the requirements of the proposed investigations. The strategy of investigations mainly comprised the following :

1] *Critical appraisal of all available previous literature and available information*: This consisted of (i) Obtaining optimum information on the geological and structural aspects of Banaskantha and its neighborhood, and (ii) collection and compilation of various environmental factors and parameters including those of climate and water resources. The geological details were mainly obtained from the published literature of various government organizations and academic institutions. The information thus obtained was supplemented and scrutinized with the help of trips to selected areas for on-spot field observations. Data on some aspects of geology as well as that pertaining to environmental factors (landscape, climate, rainfall, water resources, soils etc.) were obtained by going through numerous unpublished reports prepared by different Governmental and Non-Governmental agencies. In nut-shell every possible source to procure all available information relevant for the present study was tapped. This exercise proved very useful as a backdrop facilitating the course of investigation.

2] *Procurement of the details of geomorphic features and terrain characteristics, from Survey of India topoheets and Satellite Imagery(IRS\FCC)*: A detailed examination and study of topographic sheets on scales 1:1000,000, 1:250,000, and 1:50,000 was carried out. All features recorded on the topographic sheets, were suitably categorized in the light of the factors of geology and climate. Satellite Imagery (FCC 1:250,000 scale and 30 m resolution) covering the entire Banaskantha district were also critically studied. The information thus obtained from the topographic sheets and Satellite Imagery was again subjected to selective field checks.

3] *Visits to various water resource development schemes*: Visits were made to (i) Major, Medium and Minor dam sites, (ii) Tubewell and openwell irrigation\water-supply schemes.

During these visits, on the spot data were obtained through perusal of reports and personal discussions with the project personnel.

4] *Collection of secondary\raw data collected by different organizations and research institutions*: This data had remained more or less unutilized by the sponsoring organisations. But for the same were retrieved, compiled and analyzed for the purpose of this study.

5] *Processing of the data and information obtained through points 1 to 4 above*: The information so obtained was analyzed and synthesized to bring out the geoenvironmental characteristics of Banaskantha district. On the basis of this exercise it was possible to divide the study area into three units, each marked by its own set of characteristic surface and subsurface features.

6] *Attempt to prepare a geoenvironmental model*: Taking into consideration the behaviour of surface and sub-surface water regimes vis-a -vis terrain factors and climatic conditions, an attempt has been made to construct a viable model for the optimum utilization of water resources of the study area.

AREA PROFILE

LOCATION

Geographically, the district is located in the northern most part of Gujarat. It lies between North Latitudes 23^0 35' to 24^0 43' and East Longitude 71^0 1' to 73^0 2' (Fig 1.1). It forms a part of the state boundary with Rajasthan in the north and it is bordered by Sabarkantha in the east, Mehsana district in the south and the Rann of Kachchh in the west. The district covers parts of five adjoining Survey of India Degree Sheets (1:250,000) Nos.

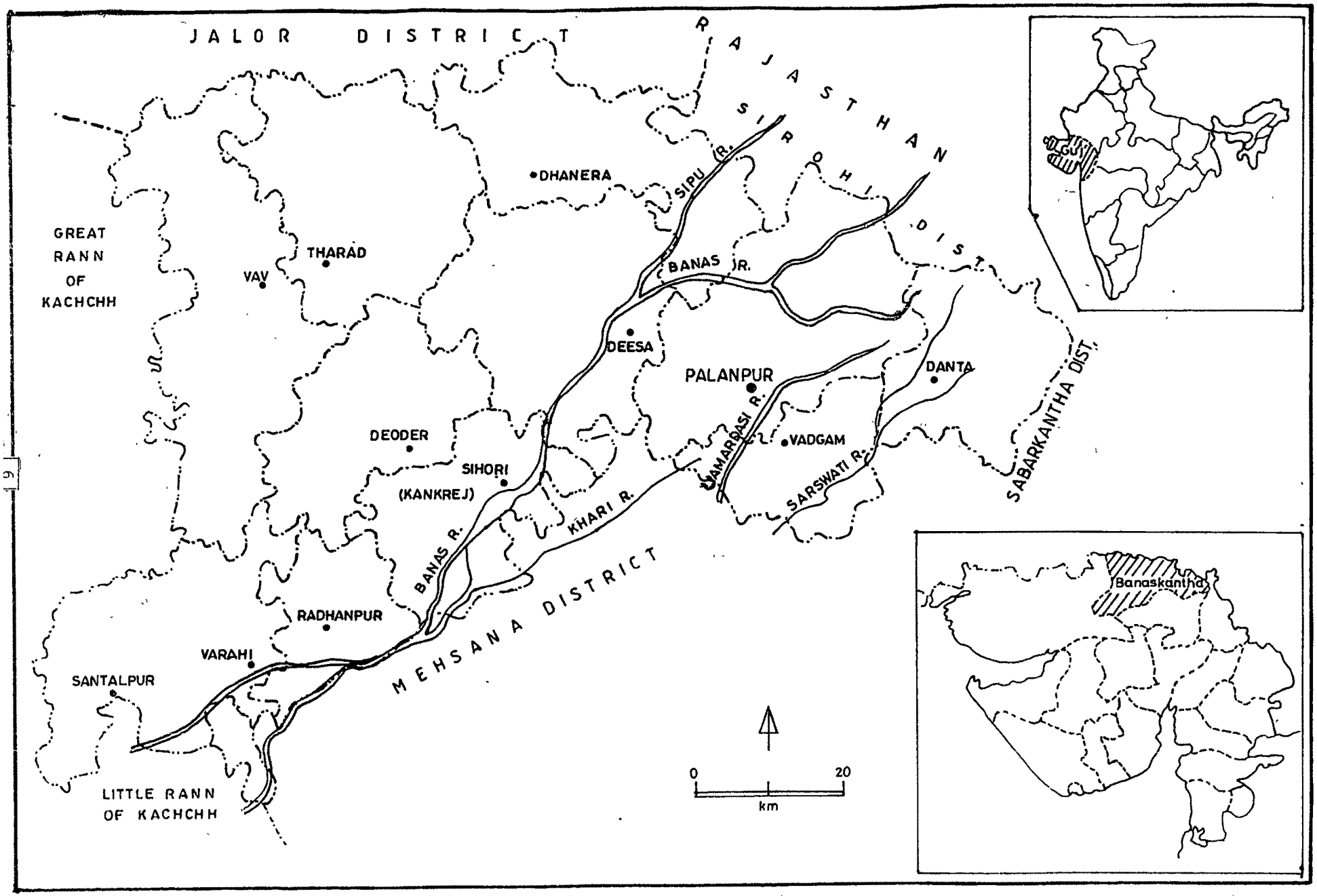


FIG-1.1 LOCATION MAP OF BANASKANTHA DISTRICT

45D, 45H, 46A, 40P and 41M. The area is covered in 33 different Toposheets (1:50,000) spreading over an area of 12,703 sq km and constitutes 6.5% of the total area of the state. The district is about 192 km E-W length and is about 112 km in N-S width. For administrative purposes it has been divided into 11 talukas, Palanpur being the headquarters.

PHYSIOGRAPHY

The district is marked by a sharp physiographic contrast with rocky highland in the east and wide stretching plains covering the central and western parts (Fig 1.2). The hills form the southwestern extension of the Aravalli mountain chain. The highest peak of Mt. Abu (1722 m AMSL) of the Aravalli lies just 25 km to the northwest. Its extension in the district forming the Jesor-Chotila group of hills where highest peak is known as Ranitunk (1090 m). The other group of hills in the Ambaji area is locally known as Arasur hills. It includes the important peaks of Gabbar, Diwania, Gurudev-no-Dungar, etc., and show an elevation range of 600 to 800 m. The hills have a general NE-SW trend. The valley of Banas separates the Jesor hills from the Arasur hills. The hills terminate near Dantiwada and Palanpur, and get merged into the sandy plains at an elevation of about 200 m. The plains have a general westerly slope; stretching for about 120 km, these merge into the Great Rann of Kachchh. The plains are dotted with mounds of stabilized sand dunes. The sandy plain, to the north extends into Rajasthan; and to the south it merges into the alluvial plains of Mehsana.

The district has a peculiar drainage pattern (Fig. 1.3). The eastern part has a close network of several rivers like Banas, Sipu, Saraswati, Sabarmati, etc. While the central and western parts relatively have very poor drainage development, except the main truck of Banas. The river Banas forms the important drainage of the district. It rises from the Pindwara hills (1097 m AMSL) in the adjoining Sirohi district (Rajasthan) and it enters the

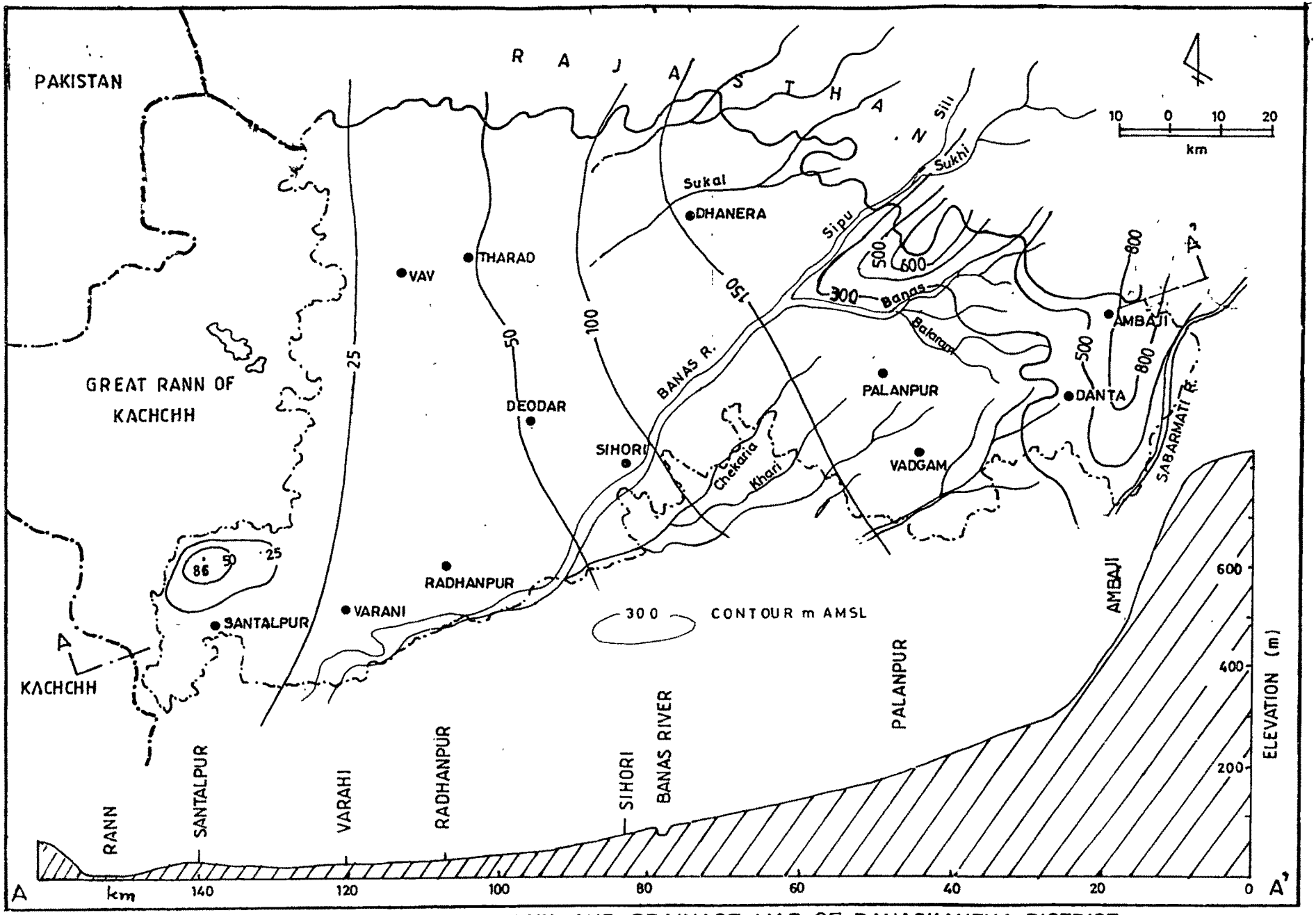


FIG-1.2 PHYSIOGRAPHY AND DRAINAGE MAP OF BANASKANTHA DISTRICT

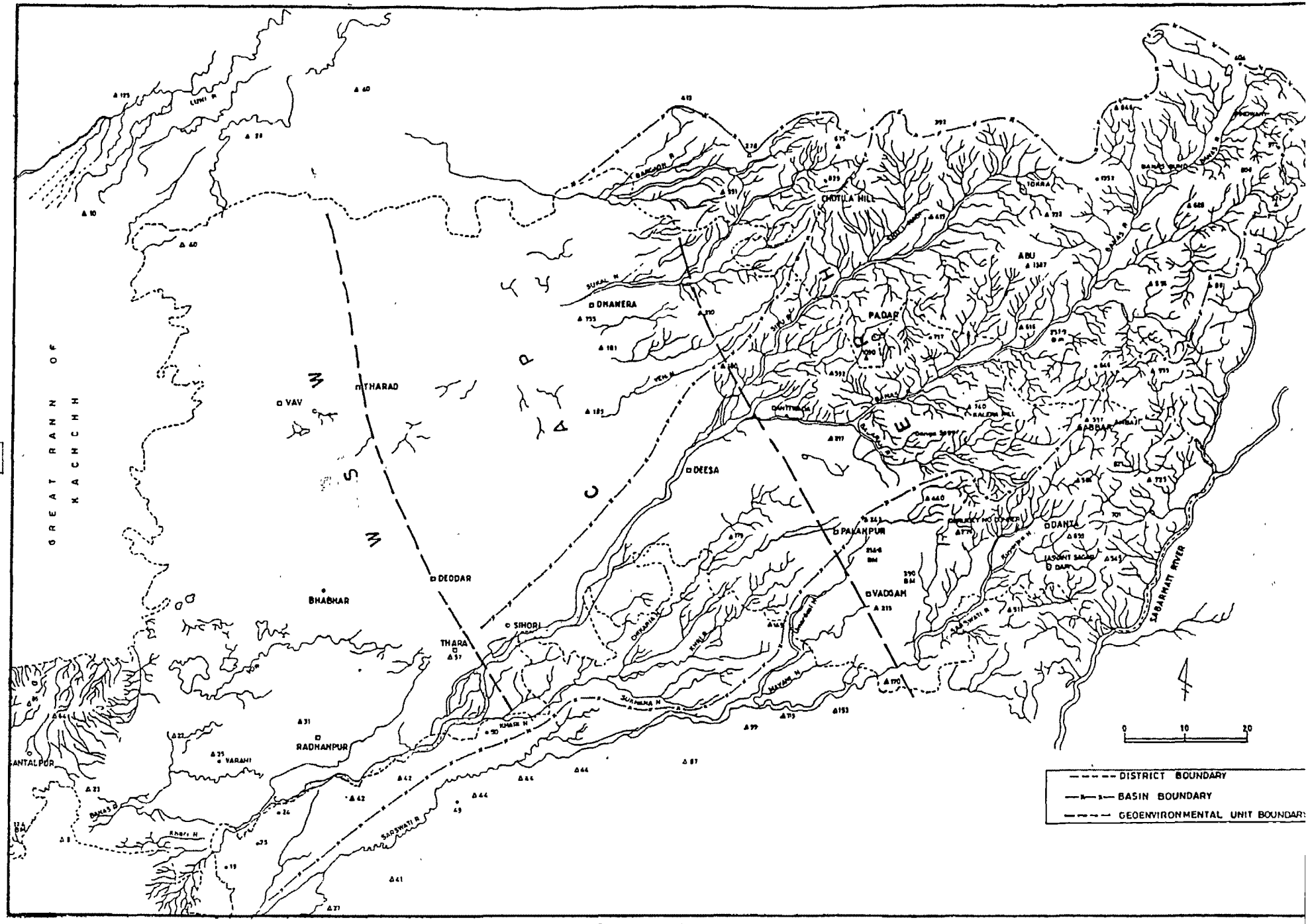


FIG- 1·3 DRAINAGE PATTERN OF BANASKANTHA DISTRICT

area from northeast and flows southwesterly. Downstream from Sihori(Kankrej taluka) it runs all along the southern boundary of the district. Sipu is the next important river a major tributary of Banas. Numerous smaller streams drain the rocky highland and merge into the Banas, the important among them being the Balaram, Kalari, Gujudi, Selvan, etc. Further downstream in the sandy plains, important tributaries are Chekharia and Khari. The eastern limit of the district with Sabarkantha is marked by the river Sabarmati. The streams of Saraswati, Arjuni and Umardasi drain the area to the south of Banas. The hilly area north of Sipu is drained by the streams of Ven, Peplu, Rel, Sukal, Bargoan and Luni. All these streams after debouching from the hills, flow for short distances and then finally disappear in the sandy plains. The northwestern part of the area is conspicuous by a total lack of drainage.

GEOLOGY

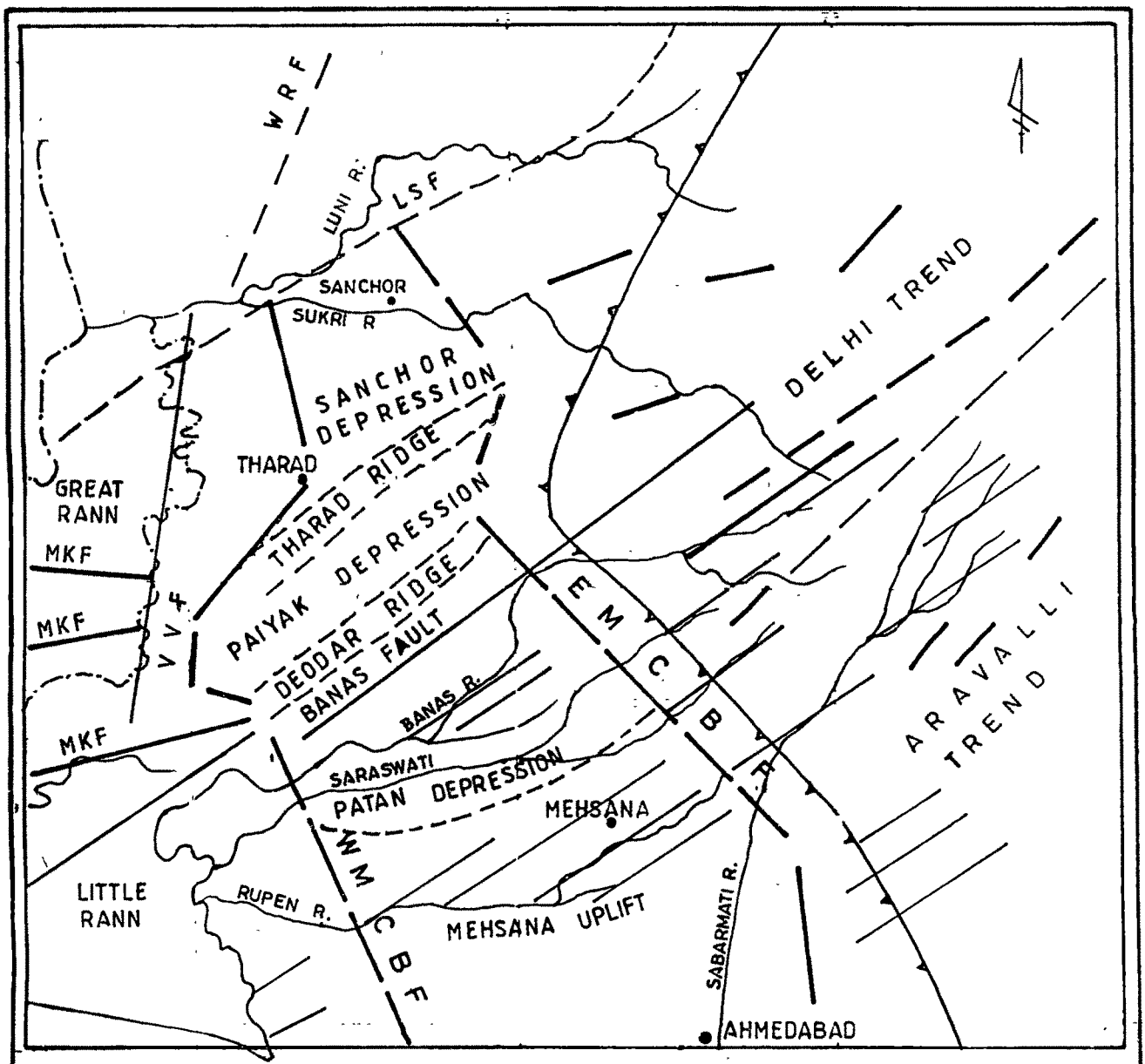
The eastern rocky highland forms the southwestern extension of the Delhi Supergroup of Rajasthan. It is made of complexly folded and faulted metasedimentaries, which are extensively intruded by Erinpura Granite. There are a number of minor mafic intrusives of Pre and Post-Erinpura Granite. The highland gradually merges towards southwest into the sandy alluvial plains. The central and western parts of the district are covered with terrestrial deposits termed in the literature as 'Quaternary Alluvium'.

Cambay Basin forms major part of the district. The Cenozoic deposition of Tertiary and Quaternary, has taken place in the Cambay Basin depression, bounded by the two basin bounding faults. The Eastern Margin Cambay Basin Fault (EMCBF) marks the junction of the Quaternaries with the rocky highland whereas the Western Margin Cambay Basin Fault (WMCBF), broadly coincides with the line separating the Central Alluvial Plain (CAP) with the Western Saline Wasteland (WSW). Various structural elements of the northern part of the

Cambay Basin, including the oblique faults of various generations cutting the Quaternary deposits comprising of fluvial, fluvio-aeolian, fluvio-marine and aeolian environments are encountered in the limit of the Banaskantha. The tectonic setting of the district vis-a-vis Cambay Basin ideally provide the tectonic framework of the study area. The Quaternaries have been subjected to several sets of fractures related to basin bounding faults and transverse faults cutting the basin, and these are well reflected in the geological set up of the district. The Varhi-Vav fault running parallel to the WMCBF marks the westernmost limit. The two transverse faults Luni-Sukri Fault (LSF) and Banas fault (BF) mark the northern and southern limits of Sanchor-Patan Block (Fig. 1.4). Further in the north the Quaternaries extend into the neighbouring district of Sirohi in Rajasthan, to get finally covered by the loose sands of the Thar desert.

CLIMATE

The district is characterised by a general semi-arid to almost arid climate with an average annual rainfall of 555 mm (Fig 1.5). However, the area shows a wide range of rainfall variation; 400 mm at the extreme west to more than 800 mm in the eastern extremity. More than 90% of the precipitation is received during southwest monsoon months from June to September. Depressions during July and August originating in the Bay of Bengal move in a westerly or west-north-westerly direction and reach the district causing heavy rain and gusty winds. Thunderstorms occur in the later half of the summer and in early parts of the SW monsoon season. Although, mean annual temperature is about 26^0 C, its extremes range from 47^0 to 2^0 C. May is the hottest and January is the coldest month. The winds generally blow from southwest and west. During winter, winds also blow from north. Dust-storms are quite common. Clear skies and low humidity are the general characteristics of the climate. In general the climate is harsh and oppressive.



REFERENCE

WRF – WEST RAJESTHAN FAULT

LSF – LUNI-SUKRI FAULT

VVF – VARAHI-VAV FAULT

EMCBF– EASTERN MARGIN CAMBAY BASIN FAULT

WMCBF- WASTERN MARGIN CAMBAY BASIN FAULT

— — TECTONIC TREND - CAMBAY BASIN

——— MAJOR KUTCH FAULTS(MKF)

——— OTHER FAULTS

– – – YOUNGER FOULTS

FIG-1·4 STRUCTURAL SET UP OF BANASKANTHA DISTRICT

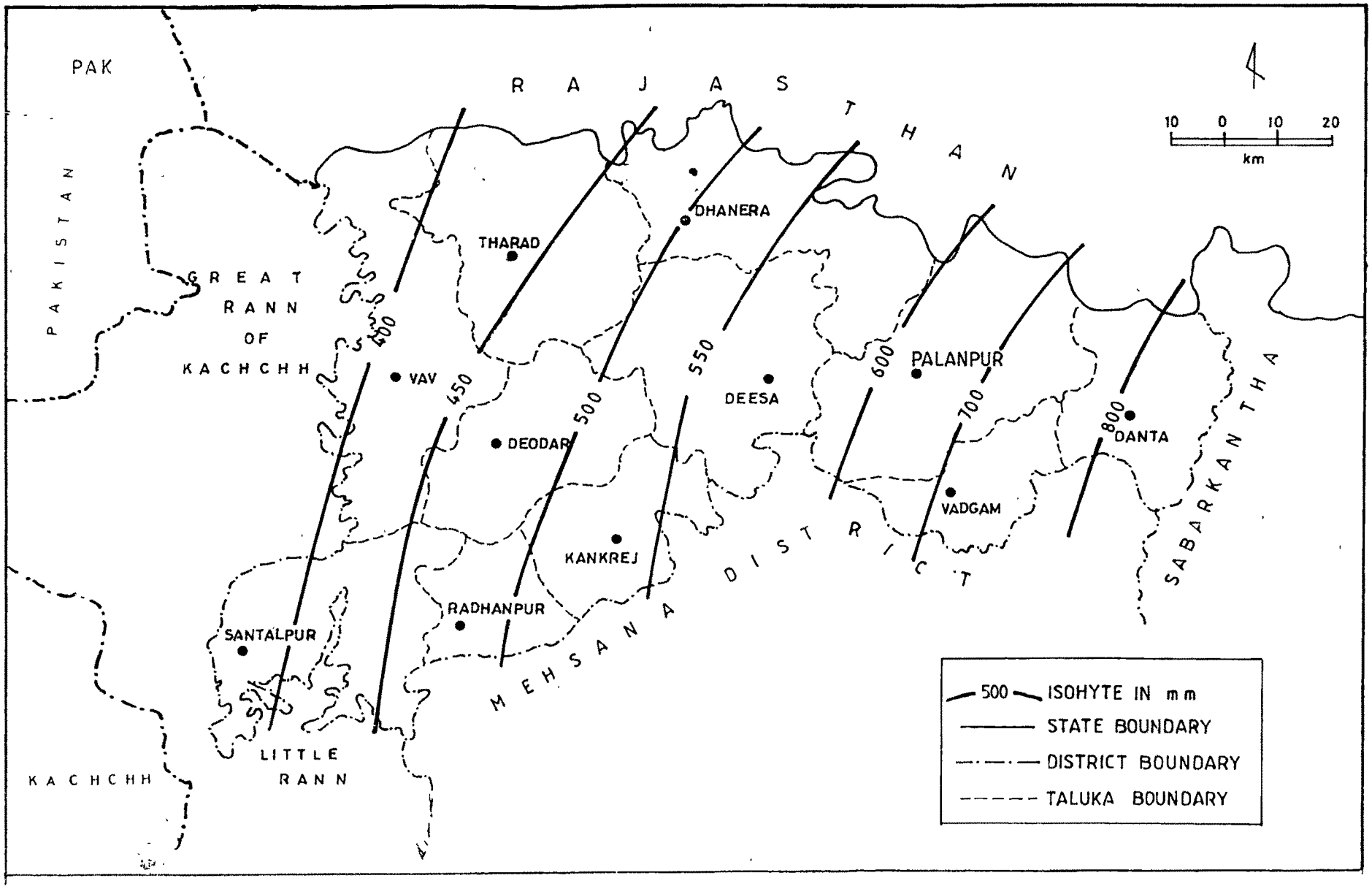


FIG- 1·5 ISOHYTE MAP OF BANASKANTHA DISTRICT

GEOENVIRONMENT

As the term 'environment' has a very broad based connotation and includes social, religious, political, etc. it has been found desirable to use the word 'Geoenviornment' to highlight the role of various earth-related endogenic and exogenic processes. In a broad sense, it is synonymous for the physical environment of an area dependent on various geological factors, behaviour of surface and sub-surface water and the interaction of climatic conditions with the earth's surface.

The district of Banaskantha, provides a very good example of geoenvironmental diversity and the role played by various controlling factors viz., terrain attributes, climate and water regime. All these show distinct variation in the different parts of the district; on the basis of the variation, the area has been divided into three well defined geoenvironmental units from east to west; viz. (i) Eastern Rocky Highland, (ii) Central Alluvial Plain and (iii) Western Saline Wasteland. Each of these units exhibits its own distinctive surface and subsurface water regimes. Water constitutes the most important resource of the Banaskantha district as it occurs under very heterogeneous conditions. Its harnessing and utilization has been a major aspect of the developmental activity. The western part has average rainfall of about 430 mm with less than 40% dependability and has poor surface water potential, with the area being categorized as drought-prone. On the other hand, the eastern hilly tract has an average rainfall of 800 mm with 55% dependability, that produces surplus surface runoff, which has been utilized by constructing dams across Banas (Dantiwada), Saraswati (Mukteshwar), and Sipu (Sipu), creating good irrigation facilities. Groundwater, in the eastern hilly tract has limited prospects. The central alluvial plain is endowed with extensive groundwater aquifers with ample supply which have been developed as a major source for

irrigation. In the western part the quality of groundwater deteriorates and hence it has limited use .

FLORA

The wide diversity in climate and topography of the area has resulted in a variety of forest growths. Alluvial areas are mostly devoid of forest cover. On the basis of National Classification, the forests are mainly differentiated into 2 main types:

(1) Tropical dry deciduous forests in parts of Ambaji, Danta, Amirgadh and Iqbalgadh range.

(2) Tropical thorny scrubs in the remaining area i.e Radhanpur range.

Species like *Boswellia Serrata Roxb* and *Lannea grandis Engl.* predominate i.e. 30% of growing stock while *Acacia catechu Willd* and *Delbergia latifolia Roxb* forms 20% and *Anogeissus Pendula Edgew* predominates the foothills. The most common species in the hilly region in the top canopy are *Anogeissus latifolia* Wall (Golia Dhav), *Salmalia Malabarica Sch. E.* (Simal), *Mitragyna parvifolia Korth* (Kalam), *Milliasa tomentosa Roxb.* (Humb), *Dalbergia latifolia Roxb.* (Sissum), *Emblica officinalis Gaerth* (Amla), *Terminalia bellirica Roxb.*(Baheda), *Tamarindus indica Linn.* (Amli), *Aegle marmelos Corr.* (Bili), *Diospyros melanoxylon Roxb.*(Timru), *Boswellia serrate Roxb.* (Salad), *Lane grandis Engl.* (Golada), *Albizia odoratissima Benth* (Kalasiris), *Grewia tiliaefolia Vahl.*(Dhaman), *Acacia catechu, willd* (Khair), *Syzygium cumini Sk* (Jamun) and *Ficus glomerata Roxb.* (Umardi). In the middle Canopy are *Anogeissus pendula Edgew* (Kala Dhav), *Balanites roxbughii Planch* (Hinger), *Butea monosperma Taub* (Khakhara), *Wrightia tinctoria R. Br.* (Dudhi), *Cassia fistula Linn.* (Garamala), *Embliea officinalis Gaerth* (Amla), *Zizyphus jujuba Lamk* (Bor), *Acacia eburnea willd* (Tatakiyo Bawal), *Dendrocalamus strictus Nees* (Bamboos). In lower

Birds found in Gujarat are represented in the district also. The common species are *Podiceps ruficollis* (Little Grebe), *Pelecanus onocrotalus* (Rosy Pelican), *Phalacrocorax carbo* (Cormorant), *Anhinga rufa* (Snake Bird), *Anastomus oscitans* (Openbilled stork), *Ciconia episcopus* (Whiteneck Storh), *Threskiornis melanocephala* (White Ibis), *Platalea leucordia* (Spoonbill), *Babulcus ibis*, (Cattle Egret), *Phoenicoptrerus ruber* (Flamingo), *A Poecilorhyncha* (Spot Billed Duck), *A acuta* (Pintail), *Tadorna ferruginea* (Ruddy Shelldduck), *G. Fulvus* (Griffon), *Gyes bengalensis* (White backed Vulture), *Aquila rapax* (Tawny Eagle), *A. badius* (Shiakara), *Pava cristatus* (Peafowl), *Francolinus pictus* (Painted Partridge), *Anthropoides virgo* (Demoiselle Crane), *Choriotis nigriceps* (The Great Indian Bustard), *Hydrophasianus Chirurgus* (Pheasant tailed Jacana), *Pterocles exustus* (Indian Sandgrouse), *Taccocua leschenaultii* (Sirkeer Cuckoo), *Tayto alba* (Barn Owl), *Ceryle rudis* (Pied kingfisher), *Corvus corax* (Raven), *Dendrocitta Vagabunda* (Tree Pie), *Prinia socialis* (Longtail Warbler) etc. are some of the common species found in the region.

Snakes are also not uncommon. *Python molurus* (Ajgar), *Ptyas mucosus* (Rat-snake), *Natrix piscator* (Checkered keel-back), *Natrix Stolata* (Buff Striped keel-back), *Eryx johnii* (John's Sand Boa) and *Psammophis leithi* (Sand Snake), are non-poisnous varieties. While some of the poiseonous snakes found are *Nagaraja* (Cobra), *Vipera russell* (Russell's Viper), *Bungarus caeruleus* (Common Krait), and *Trimeresurus gramineus* (Bamboo Pit Piper).

COMMUNICATION

A well knit network of metalled and unmetalled roads connect Palanpur, the headquarters of the district with the various neighbouring towns and villages. National Highway No. 15 passes through the district (Fig 1.6). All important places are linked by a number of State Highways and major district roads. Three sections of the Metre Gauge

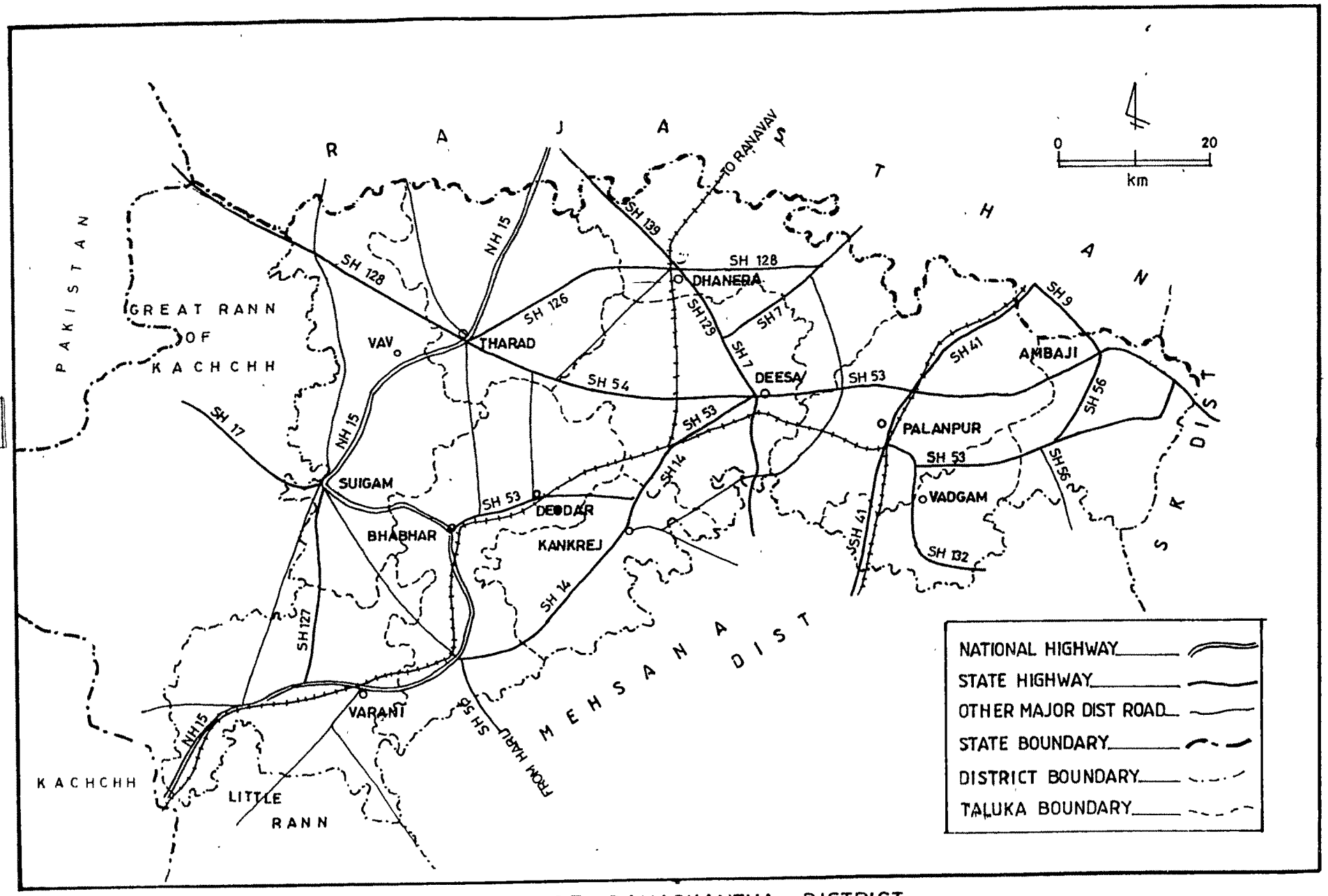


FIG-1.6 COMMUNICATION MAP OF BANASKANTHA DISTRICT

Western Railway link the area with Delhi, Ahmedabad and Gandhidham. The Gujarat State Road Transport bus service connects and covers almost all the villages. Private jeeps and camel cart also form a popular means of transport.

PEOPLE

The population of 11 talukas of the district as per the 1991 Census, is 21.6 lacs, of which 90% are rural (1368 villages) and 10% are Urban (7 towns). The decennial population growth rate is 29.66%. Deesa taluka has the highest growth rate of 35.12% while the lowest is that of 16.62 % for Santalpur. Population density of the district is 170/ sq km Palanpur taluka has the highest density of 275/sq km while Santalpur has 64/sq km. The demographic details of the district are given in (Fig 1.7).

Both Hindus and Muslims inhabit the district. Among the Hindus, Brahmin, Vania, Luhana, Bhatia, Rajput, Thakarda, Kanbi, Sathvava, Nadoda, Koli, Khatri, Salvi, Bhavsar, Soni, Suthar, Kansara, Salat, Luhar, Darji, Bharwad, Ahir, Sarania, Od, Gola-rana, Bajania, Vadi, Kaval, Vaghri and Sadhu are the chief castes. Among Muslims, Shaikh, Sayiad, Mughal, Pathan are of foreign origin and Mahdevia, Bohra, Momin, Memon and Khoja are the muslims converted from Hindus.

Culturally, the interaction of this district with Marwad, Rajasthan and Sindh is quite significant. In the past, people migrating from west through Baluchistan, Sindh, Punjab and Rajasthan made their way to Saurashtra, via this district. Migrants coming from South Rajasthan have also made considerable cultural impact on the people of this region. Before the advent of the Aryans in this region, the area was inhabited by aborigines like Bhils, Nagas etc. Buddhists and Jains also made their cultural impact on the people of this region. The

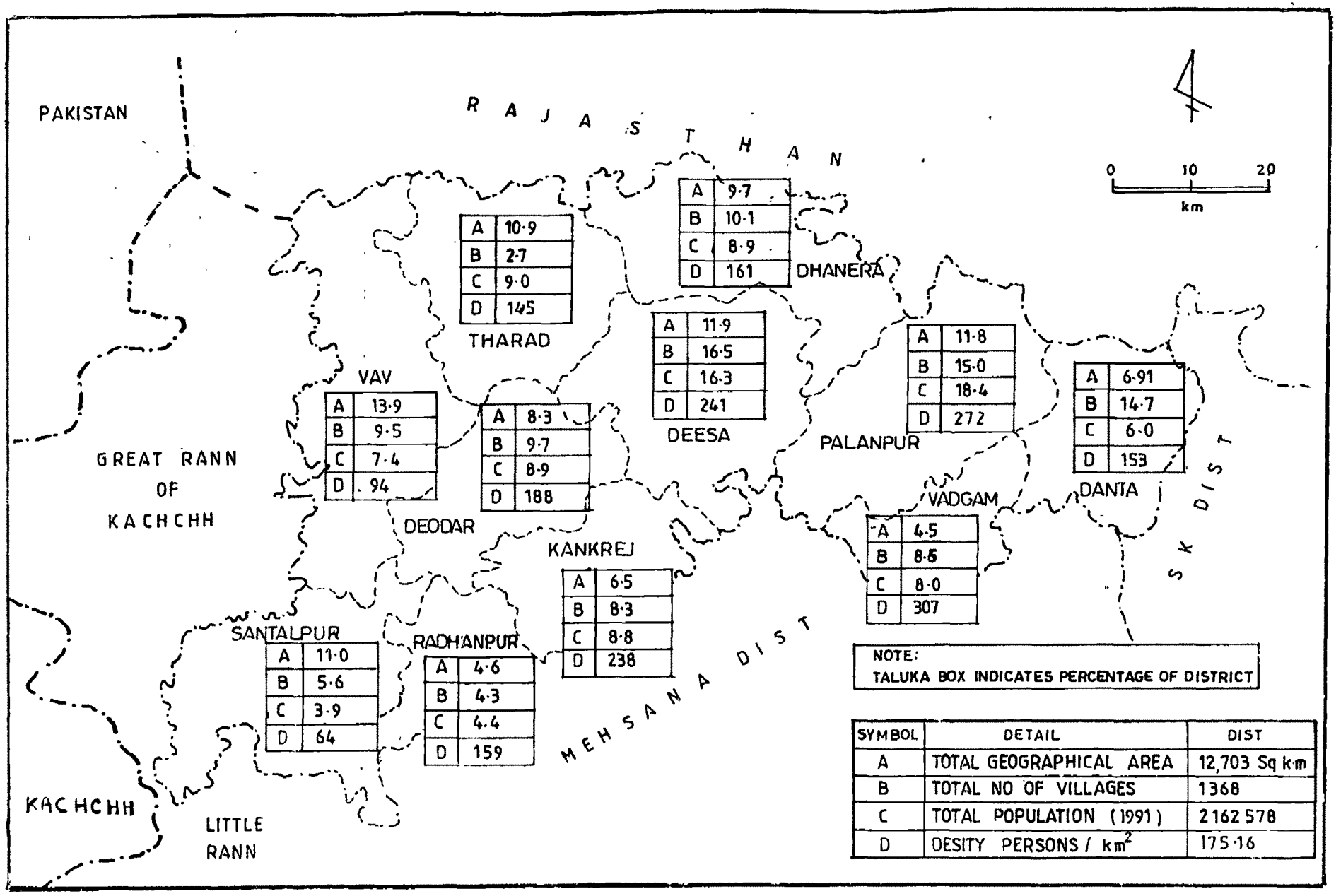


FIG 1·7 DEMOGRAPHIC MAP OF THE BANASKANTHA DISTRICT

district, with a hoary past is now on a threshold of a cultural revolution on account of rapid spread of education amongst the masses.

SOCIO-ECONOMIC STATUS

Agriculture is the main occupation, and almost 80% of the districts population is engaged in agriculture and allied activities. Nearly 69% of total area is under cultivation. Cattle rearing, once a primary occupation, is now taken as an alternative\ additional source of income. A small percent falls in trader's category. Mostly people are occupied in agriculture from June to October. Some of them migrate to other nearby towns and cities to work as labourers for rest of the year.

The inhomogenity of natural resources has influenced the socio-economic status and attitudes of the population. People living in hilly terrain earn their living from forest produce, light agriculture and as industrial labour, whereas in the central part of the district having rich agricultural land, the population is flourishing with better living conditions and higher rate of literacy. The development in irrigation has tremendously improved the agricultural earning, thereby raising their economic status. In the saline plains of the west, there is meagre agricultural potential and here cattle rearing is the main source of earning. However, this resource base is poor to meet the basic needs of the people and hence the western part of the district is economically backward.